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MODERN METHODS OF DYEING SOME MANUFACTURED FIBERS*

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IN THE dyeing and finishing branch of the textile industry, as in every other step of the conversion of fibers into consumer goods, it is well to maintain our perspective by remembering how brief is man's experience in the dyeing of manufactured fibers as compared to our ages of experience in the dyeing of natural fibers. Our ancestors gradually accumulated empirical knowledge of dyes, of fibers, and of how to color textiles. For thousands of years the skill of generation after generation of dyers was focused on how to apply a *few* natural dyes to a *few* natural fibers. Many a dyer spent his entire life applying one color to one kind of fabric.

The influence of science on the ancient craft of dyeing is about one hundred and fifty years old. Less than one hundred years ago the chemist "hit the jack pot" of synthetic dyes, out of which has flowed and still flows the myriad of dyes of all classes, colors, and degrees of fastness with which the modern dyer is confronted today. Only fifty years ago, the first puny strands of "artificial silk" trickled from spinnerettes and began to grow into the present torrent of viscose, cuprammonium, and acetate rayons, nylon, vinyl, vinylidene, casein, glass, and other manufactured textile fibers which reach the modern dyer, either alone or in combinations with each other and with cotton, linen, wool, and silk in the apparel and household fabrics of today.

The creation of *beauty* of texture and of color in textiles calls for artistry and craftsmanship, as it always has and always will, but only by some understanding and application of our current scientific and technological knowledge of fibers, of dyes, and of dyeing, can the modern dyer hope to master this modern profusion of materials in order to endow the beauty of his colors with the highest degree of economy and color fastness attainable for any given end use of each fabric which comes to his hand.

All of the chemical and physical characteristics of a given fiber play a part in its behavior in dyeing and finishing, but the principal aspects of a fiber's "personality," from the dyer's point of view, are its chemical reactivity, its swelling behavior in water and other liquids, and its thermoplasticity, both wet and dry. An excellent summary of the properties of manufactured fibers has recently been published by W. D. Appel.[1]

FIBER PROPERTIES OF INTEREST TO THE DYER

We can characterize the "personality" of the principal manufactured fibers whose dyeing will be discussed in this paper as follows:

Regular Tenacity Viscose Rayon

Chemical Reactivity: Viscose rayon is composed of pure cellulose. Therefore its chemical reactivity is similar to cotton, but it is more sensitive to tendering by acids and to swelling by water and by alkalis because of its "looser" internal structure. All of the types of dyes which are used on cottons have an affinity for viscose rayon.

Swelling Behavior: Viscose fibers are very hygroscopic, the amount of water absorbed at 100 per cent R.H. being about 45 per cent, as compared to 13 per cent regain at 65 per cent R.H. The fiber swells readily in water, the area of the cross-sections of a wet fiber being some 50 per cent greater than that of the air-dry fiber. Alkali causes a still greater swelling.

The swelling of textile fibers is usually accompanied by a reduction in strength which necessitates greater care in handling in the wet state, but, from the standpoint of dye absorption, swelling is of tremendous importance because it opens up the internal structure of the fiber and permits the entry of dye molecules which could not penetrate the unswollen fiber. The basic principle of wash-fast dyeing is intimately connected with swelling phenomena in all fibers, as we shall see. Vat dyes are fast to washing because the alkali-soluble leuco-form can be carried into the swollen cotton or viscose fiber and there converted by oxidation into the insoluble form which consequently cannot escape from the fiber when it is again swollen in the wash liquor.

The strength of cotton is actually slightly higher in the wet state. It can therefore be handled rather roughly in wet processing without damage to the fabric. The wet strength of viscose rayon, on the other hand, is about one half of its dry strength and it stretches more readily. A wet viscose fabric is therefore more easily distorted and abraded and must be handled with greater care while wet, and dried preferably without tension. Its strength is completely recovered by drying, but if it has been over-stretched while wet, the textural quality of the fabric suffers and it will shrink more the next time it is wet as, for instance, in laundering.

Thermal Behavior: Viscose rayon is not a thermoplastic material. It is not, therefore, weakened by dry heat but is, in fact, stronger because of the elimination of moisture. The effect of heat in the wet state is due solely to the swelling phenomena described above. Tendering and scorching occur at excessively high temperatures, the effect being dependent upon temperature and time of exposure.

Cellulose Acetate Rayon

Chemical Reactivity: Cellulose acetate is an ester, that is, an organic salt made by the chemical combination of an organic acid (acetic acid) with an alcohol (cellulose). Like all esters, it can be decomposed (hydrolyzed or saponified) by reaction with a strong base (alkali), with the consequent liberation of the acid and the regeneration of the cellulose. The effect of a small amount of saponification on the distinctive properties of cellulose acetate rayon is negligible, but with increasing amount of saponification, acetate

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rayon loses its own "personality" and becomes more and more like viscose rayon in its affinity for cotton dyes, its absorption of and swelling in water, and its general textile characteristics. This alkali sensitivity must be taken into account in boil-off and dyeing operations.

Acetate rayon is as stable as cotton and viscose to weak acids but, like them, can be tendered by strong acids. Concentrated organic acids, such as formic, acetic, etc., have a swelling and solvent action.

Acetate rayon shows little or no affinity for viscose or cotton dyes but is readily dyed by certain classes of dyes which are soluble in the solid cellulose acetate. Some of these are water soluble, but most are insoluble in water and are therefore applied from a bath containing a dispersion of the finely divided insoluble dye.

Swelling Behavior: Acetate rayon is less sensitive to moisture than viscose rayon. The absorbed moisture at 65 per cent R.H. is 6 per cent (regain) and at 100 per cent R.H. it is approximately 18 per cent. This lesser absorption of moisture is accompanied by a much smaller amount of swelling of the wet fiber. The increase in area of cross-section of an acetate rayon fiber from the air-dry to the wet state is about 11 per cent. This resistance to swelling in aqueous baths is an asset with respect to shrinkage control and wet strength (which is about two-thirds of the dry strength), but it is one of the primary stumbling blocks to the application of dyes other than acetate-soluble dyes. One method of overcoming the inability of dyes to penetrate cellulose acetate fibers is the solvent-dyeing procedures which will be described later. In principle, the acetate fiber is swollen by adding a swelling agent, such as alcohol, to the water bath. In this swollen state, acid dyes, which have no inherent affinity for cellulose acetate, can enter the fiber structure. The fiber is then "deflated" by removal of the alcohol by washing and drying. Subsequent swelling in water or soap solutions is insufficient to permit the acid dye molecules to escape. This principle of swelling may increase the importance for the dyeing of other types of manufactured fibers.

Thermal Behavior: Acetate rayon is a thermoplastic material which becomes softer at elevated temperatures. It should be remembered that thermoplasticity is distinct and independent of the softening and swelling due to water or other liquids. In the dry state, acetate fabrics soften and glaze when subjected to pressure or tension at temperatures ranging upward from 250°F., stick at temperatures above 300°F., and melt at about 490° F. In the wet state the combined effects of thermoplastic softening and aqueous softening most demand the exercise of care with respect to tension, squeezing, pressure, or abrasion at temperatures near and above the boiling point of water.

The thermoplastic character of acetate is turned to good advantage in the embossing of crepe-type textures and of moire and other patterns, and in the making of permanent creases and pleats in garments.

Nylon

Chemical Reactivity: Nylon is a protein-like synthetic polymer composed of linear molecules whose chain structure is similar to the polypeptide chains which form the basic structure of silk and of wool. From the standpoint of chemical constitution, nylon has an affinity for dyes which dye wool or silk. It also absorbs acetate dyes in a similar manner to their absorption by acetate rayon but with some differences in the fastness properties of colored fiber. Nylon is essentially inert to most organic acids and to alkalis, but is degraded by mineral acids and oxidizing agents.

Swelling Behavior: The moisture absorption of nylon fibers is very low, being 4 per cent at 65 per cent R.H. and 8 per cent at 100 per cent regain and the swelling in water is reported as negligible. Consequently, its wet strength is about 85 to 90 per cent of its dry strength.

However, it should be remembered that, although the breaking strength of nylon is not greatly affected by increasing humidity, the ease of stretching (and therefore of distortion of fabric) increases with increasing humidity, especially at the low tensions involved in ordinary handling. At 100 per cent R.H. nylon stretches under small tensions three times as easily as at 50 per cent R.H. Because nylon has the elastic ability to creep back to its original length when the small tensions which stretch the yarn or fabric temporarily are released, care must be taken to avoid this type of fabric distortion.

Thermal Behavior: Nylon is a thermoplastic material which glazes and sticks under pressure and stretches under tension at temperatures above 350° F. and melts at about 480° F.

It is capable of being "set" by wet or by dry treatment at an elevated temperature, so that subsequent wet treatments below this setting temperature will not cause undue wrinkling or creasing, as is likely to occur if the fabric is not pre-set.

Casein Fiber

Chemical Reactivity: Casein fiber is composed of protein molecules and, therefore, possesses the general chemical ractivity and dye affinity of silk and wool. However, because of its much "looser" internal structure, it is more sensitive to alkalis than wool and is badly disintegrated if processed in hot alkaline baths.

Swelling Behavior: Casein fiber swells easily in water and alkalis and, because its dry strength is already low, the wet strength becomes dangerously low. It is ordinarily used in blends where the other fiber carries the mechanical load, but care is essential in wet processing to avoid permanent damage.

Thermal Behavior: Casein fiber is not thermoplastic, but high temperatures should be avoided to prevent tendering.

With this brief review of the "personality" of these manufactured fibers, let us move on to a practical dyer's consideration of the modern technology of dyeing them.

THE DYEING OF VISCOSE RAYON

Viscose rayon requires entirely different handling and processing equipment from cotton due, in part, to the softer nature and the greater water sensitivity which has already been mentioned and, in part, to the more delicate textures of many fabrics in which filament viscose rayon is employed.

Flat fabrics like taffetas and satins are generally scoured and dyed on a tensionless jig. In some cases, such as when tight selvages are encountered on low count pigment taffetas, they are first padded with a selected group of direct colors, then scoured and dyed simultaneously on either the reel or jig.

Many fabrics constructed with filament viscose rayon are crepe types which require an embossing prior to setting and scouring. After embossing, these fabrics are treated at 120° F. from two to four minutes in a 2½° Bé caustic soda solution in the open width, and immediately scoured at 175° to 190° F. This alkaline treatment improves the dye penetration and the levelness of the dyed fabric. Boiling-off may be carried out either on a continuous rope type of boil-off machine or on the full-width, continuous, carrier-type machine. Viscose crepe fabrics are usually dyed with a selected group of direct and developed dyestuffs on an ordinary reel machine. Recently, many plants have installed a new type of dyeing machine which eliminates the tedious job of separating each individual piece. The principle employed is to convert an ordinary dye reel to handle the pieces in endless form by installing a cross-over floating box directly back of the small reel. For example, a ten-piece dye lot is sewed together in the make-up department, then boiled off, dyed on an endless type dye reel, extracted, opened, dried, and finished without breaking a seam.

Many fabric constructions which contain filament viscose rayon, either alone or in combination with spun rayon, may be processed by the various methods described later for the fast-color dyeing of spun viscose rayons. The controlling factor is the suitability of the fabric construction and

the type of finished hand required in the finished fabric.

The increased demand for spun rayon fabrics is of paramount interest at the present time. Many constructions may be boiled off on the dye reel. However, the better qualities are usually boiled off on the open-width, carrier type, continuous machine, which is a comparatively new development.

It is not possible to produce many shades of high fastness to light and washing with colors in the direct and developed dyeing group. However, many spun viscose fabrics are subjected to hand washing methods such as are used for woolen and silk goods. For such fabrics there are many direct colors which will stand up to hand washing and yield reasonably good light fastness. Through a careful selection and application of the better class of direct dyestuffs, a limited number of shades may be produced to withstand hand laundering at 105° F. and from 15 to 50 hours' exposure on the Fade-Ometer. In order to obtain the maximum fastness with direct colors, they must be slowly and carefully dyed and maximum exhaustion of the individual color obtained. Rinsing after dyeing should be at a temperature of 10 to 20 degrees higher than the temperature which will be used by the consumer in washing the finished garment. A given dyeing is somewhat faster to light on bright fibers than on dull fibers.

Many filament and spun viscose rayon fabrics are finished with synthetic resins after dyeing to increase their resistance to creasing and shrinkage. In some instances the light fastness of certain direct colors is thereby decreased and in most cases the wash fastness is improved.

Many spun fabrics need higher fastness properties than the filament crepe types, and it is here that the mechanics of processing as well as the choice of dyes plays an important part. To produce rayon fabrics with guaranteed fast colors, it is necessary to use a carefully selected group of vat and azoic dyestuffs. The application of these dyestuffs calls for skill in the mechanics as well as in the chemistry of dyeing. It is in the field of mechanical handling that many interesting and successful new ideas have been applied to the problem of vat dyeing.

The vat colors may be applied by the following methods:

1. Pigment Pad—Jig Development
2. Modified Pigment Pad—Jig or Reel Development
3. Pigment Pad—Steam Reduction—Continuous Process
4. Pigment Pad—Modified Jig Development
5. Leuco-Esters of Vat Colors

1. *Pigment Pad—Jig Development*

The use of the pigment pad process has been made possible primarily by the dyestuff manufacturers' success in increasing dye dispersion. Of equal importance is the improvement in padding equipment and the development of the so-called tensionless type of jig. The dispersed vat dyestuff in combination with a non-foaming wetting agent is padded on a well scoured and pre-shrunk fabric. After padding, the roll of goods must be suspended in air to prevent crush marks and migration prior to the jig reduction. In the case of all-viscose rayon fabrics and combinations with cotton, the reduction is carried out on the jig in a caustic soda—sodium hydrosulfite—sodium chloride bath, then oxidized with suitable oxidizing agents, scoured, and rinsed.

Migration of dyestuffs in their insoluble state during wet processing is always a cause of difficulty to the dyer, because it produces streaky and blotchy shades. It is only quite recently that it has been found that small additions of solubilized gums (such as lime-free Gum Karaya) to the dispersed vat dyestuff will reduce migration to a minimum. Many viscose fabrics processed by the pigment pad method show a decided loss of hand, a thinness, and an excessive shrinkage when made up into garments. Even fabrics which have been boiled off and shrunk on the continuous, carrier-type boil-off machine, dried loose in a loop drier to obtain maximum shrinkage and fullness of hand, and then dyed by the pigment pad method tend to come out thin and distorted as compared with the fabrics prepared in the same way but dyed with direct colors on the reel dyeing machine. For this reason the pigment pad-jig reduction method is limited to fabrics of certain constructions.

2. *Modified Pigment Pad—Jig or Reel Development*

This condition has led to the development of other processes in an attempt to overcome the distortion and unfavorable hand. It was thought that the addition of a padding and binding agent would prevent undue distortion of the pre-shrunk fabric and, therefore, control the finished fabric shrinkage. This process has been called the "modified pigment pad—jig development process." Pigment vat dyes are incorporated into an alkaline solution of a cellulose ether which is applied to the fabric at a temperature ranging from 70° to 80° F. by the conventional pad method, followed by partial drying, at a low temperature. The fabric is then passed through an acid medium to effect precipitation of the cellulose. The dye can be then reduced on either the jig or reel machine. When reduced on the reel machine, a well stabilized fabric is obtained because the natural shrinkage is preserved. However, the effect of this cellulose finish on the hand is so marked on fabrics constructed from fine yarns that this process is limited at the present time to those constructions which are merchantable with this crisp type of finish.

3. *Pigment Pad—Steam Reduction—Continuous Process*

The original German process for applying a pigment vat color involved the use of a cellulose ether (which is soluble at low temperatures and insoluble at higher temperatures) in the padding liquor, followed by drying and then by passage through a bath containing an alkali and sodium hydrosulfite and directly into a steam ager.[2] The recently developed pad steam process is a variation of the above method which involves padding a well scoured and pre-shrunk cloth with a pigment vat dyestuff and a suitable wetting agent, followed by flue drying, and passage through a reducing bath containing an alkali, sodium hydrosulfite, and common salt. The fabric is then run directly without pre-drying through a specially constructed rapid steam ager with or without a liquid booster bath for about three-quarters of a minute in a moist atmosphere at temperatures above 212° F. This latter operation brings about a "flash" reduction of the vat dyestuff within the fabric.

The fabric is then passed through a suitable oxidation bath. It is believed by many processors that the continuous open-width, conveyor-type, boil-off is ideally suited to the oxidation stage in this process. This method of handling during oxidation tends to eliminate the objectionable formation of scrub and abrasion marks so prevalent when dull viscose fabrics, which have been dyed and reduced by the above method, are oxidized either in rope form or by pulling over a series of rollers in open width. The pad-steam process is a promising new development whose results on rayon fabrics will be watched with interest. Exceptionally good results have been reported on cotton fabrics.

4. *Pigment Pad—Modified Jig Development*

A new type of machine has been developed to replace the jig as a reduction unit for vat dyeing.[3] This machine operates at high temperatures in a low volume of liquor and complete reduction is said to be obtained in a few seconds. The pigment-padded material is run through the machine which comprises a series of narrow channels, maintained at constant temperature by heated baffles. Liquid volume is small with minimum exposure to air. This process lowers the chemical cost of reducing agents and the danger of stretching and distortion which are present in jig reduction methods. The rayon dyeing

industry, in particular, is watching the progress of this method with great interest.

5. *Leuco-Esters of Vat Colors*

The leuco-esters of the vat dyes are particularly well suited for the production of light and medium shades on viscose rayon fabrics. The conventional method of dyeing cotton may be utilized, i.e., padding the soluble leuco-colors with the addition of 0.8 to 1.2 ounces per gallon of sodium nitrite, developing by passing through a 1 to 2 per cent sulfuric acid bath, at 120° to 140° F., then skyed for ¼ to ½ minutes, rinsed, and scoured with soda ash and fatty alcohol. This process may be operated continuously or the development and washing may be carried out on the reel in the case of those fabrics best suited to processing on the reel.

A selected group of the leuco-ester type of vat colors may also be applied by incorporating the dissolved dyestuff with an alkaline soluble cellulose ether and sodium nitrite and passing directly into dilute sulfuric acid bath. Since several of these colors are sensitive to the alkali medium at room temperatures and are thrown out of solution, a careful selection of dyestuffs must be made to avoid specky dyeings.

THE DYEING OF CELLULOSE ACETATE RAYON AND MIXTURES OF ACETATE AND VISCOSE RAYON

The differences between the chemical and physical properties of cellulose acetate rayon and those of viscose rayon require that fabrics containing cellulose acetate must be processed differently in some respects from viscose fabrics. Improvements in the manufacture of cellulose acetate fibers during the past ten years have increased its stability to heat, to alkalis, and to the wet processing involved in boiling-off and dyeing. Our experience with acetate rayons made in the United States indicates that they are, in general, better in this respect than some imported acetate rayons which swell more and are not as stable to heat and fixed alkalis. This paper is based on our experience with the properties of present-day acetate rayons manufactured in the United States.

One of the most important advances in the dyeing of cellulose acetate rayons has been the development of the full-width, carrier type of pre-setting and boil-off machines by the various processors and machinery manufacturers. Due to the thermoplastic properties of cellulose acetate, much difficulty had been experienced, prior to the development of this type of equipment, in the processing of many types of fabrics containing large amounts of acetate rayon. The principle employed in this type of equipment is that of passing the fabric at full width over a series of cans or drums, in conjunction with sprays of hot water and steam at temperatures ranging from 195° to 212° F. The acetate is set at these high temperatures and is immediately carried without undue tension on to either a loop-type carrier or a floating-type, boil-off machine for periods ranging from six to thirty minutes. This kind of equipment is ideal for those fabrics which are to be box-dyed or processed by methods for fast-color dyeing which involve padding, where maximum shrinkage is important.

Certain classes of crepe fabrics containing acetate rayon, especially those styles that are to be used in the dress, blouse, and underwear trades are preferably embossed prior to the pre-setting and boil-off. Embossing rollers must be free from sharp edges or undue tendering of the acetate fabric will result.

Careful selection of dyestuffs is as essential for cellulose acetate rayon as it is in the case of other fibers. The dispersed acetate colors dye cellulose acetate, because the dyestuff is soluble in the acetate itself. One of the difficulties in the selection of suitable dyestuffs of this type is the limited range of acetate blues, greens and violets, possessing general all-round dyeing and fastness properties, particularly those of atmospheric fume fading and light fading.

The dispersed acetate dyes are of two general chemical types, azo and anthraquinone. The blue azo dystuffs available at the present time may be satisfactorily applied to many fabric constructions with excellent fume fastness and with light fastness sufficient for certain end-uses. There are a few anthraquinone dyestuffs available now which, with suitable dyeing and finishing techniques, will give satisfactory resistance to both fume and light fading for many end-uses where both are important.

We wish to emphasize strongly that acetate dyes should be selected with respect to the end-use of the fabric. Fabrics to be used for linings, evening wear, bed spreads, high-style dress goods, tie silks, etc., do not require the same fastness to light as sportswear or drapery fabrics; but, for these end-uses, extreme fastness to atmospheric fume fading is desirable. For example, a lining fabric should have three or four years' resistance to gas fading, but its light fastness is not important.

The azo blues have been used for this type of work over a period of years and have proved very satisfactory. Such colors as Eastone Blue BGF, Setacyl Direct Blue GD, Eastone Violet BGF and Setacyl Direct Violet 2R require a high dyeing temperature and controlled dyeing technique for their proper application. The enclosed and submerged types of jigs aid greatly in applying these fume-fast azo blues and violets. The principle of the enclosed jig is the maintenance of a constant temperature (approximately five degrees higher than the dye liquor) in the atmosphere in which the cloth is rolled up. The dye liquor temperature is maintained and controlled by submerged closed coils at 185° to 195° F. The air surrounding the cloth rolls is maintained at a constant temperature from five to ten degrees higher than the liquor by the injection of live steam at the top of the jig enclosure. This type of jig has also proved advantageous in processing other fibers and is now manufactured by several machinery manufacturers.

Much attention has been given to the possibilities of padding acetate rayon fabrics and then finishing the dyeing on the jig. The fabric is first treated with a suitable enzyme and a small amount of sodium sulfite to remove all traces of gelatine. It is then boiled off on an open-width, five-compartment silk washer with a sulfonated fatty alcohol in the first three compartments at 190° F. and a hot and a cold rinse in the fourth and fifth, then vacuum extracted and dried on cans.

The following is a typical formula for light shades:

0.20 pounds Eastone Blue BGF
0.05 pounds Eastman Fast Yellow GLF
0.02 pounds Eastone Scarlet BG

The dyestuff is pasted with one pound of Cellosolve and dispersed with 25 pounds of boiling water. The dispersed dyestuff is then added to a solution containing:

20 pounds zinc thiocyanate solution (33⅓ per cent $Zn(SCN)_2$)
1 pound 56 per cent acetic acid
48 pounds boiling water

The total solution is then strained through a fine-count straining cloth. The temperature must be controlled at approximately 140° F. during padding, preferably by using closed coils or by recirculating the padding liquor from the bottom of the pad color pan back into the make-up tank.

For medium shades the following formula is a typical one:

2.0 pounds Eastone Blue BGF
0.2 pounds Eastman Orange GRN Concentrated

The dyestuff is dispersed and applied in the same medium as previously described for the lighter shades.

In both cases, the padded fabric is rolled up on a shell after padding and then completed either on an open or an enclosed jig, using a fatty alcohol detergent which is unaffected by zinc salts. Additional

(Continued on Page 315)

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IDIOSYNCRASIES IN COLOR MATCHING BY YOUNG AND OLD*

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WE have in this room a group of men ranging in ages, perhaps, from twenty to seventy and this subject should not only be of interest to all, but later on, as the young grow older, will become more interesting and one of actual experience. It is a subject, which when discussed and experiments carried out, each individual must, of necessity, be honest with himself and courageous enough to stick to his convictions.

When carrying out these experiments, we, or rather the group with whom I have been working, have all made our selections independently without any previous knowledge as to what the other had chosen for his or her match.

But suppose, before we go too deeply into this discussion, we consult various scientific journals for definitions of the terms used. This phenomenon we are to discuss is known as Presbyopia.

PRESBYOPIA

Presbyopia is the defect in vision due to advancing age. It is caused by the rigidity of the crystaline lens which produces difficulty of accommodation and recession of the near point of vision so that objects very near the eyes cannot be seen distinctly. This may be corrected to a certain extent by convex glasses. We shall discuss this later.

PHYSIOLOGY

That branch of biology dealing with the processes, activities, and phenomena incidental to, and characteristic of, life or living organisms. These processes include many which are physical, chemical, mechanical, and others of a peculiar nature which we will refrain from discussing.

PSYCHOLOGY

Strictly speaking, psychology is the science of the mind. Although distinctly out of our sphere, this is a subject which has its part here. We shall see, as we go on, just how great a part these color differences are of physiological or psychological character.

So much for the human element. Now let us define the color aspects with which we have to contend.

1. HUE IS THE NAME OF A COLOR[1]

It is that quality by which we distinguish one color family from another as red from yellow or green from purple or blue. It is specifically and technically that distinctive quality of coloring in an object or on a surface; the respect in which red, yellow, green, blue, and purple differ one from another; that quality in which colors of equal luminosity and chroma may differ.

2. VALUE IS THE LIGHTNESS OF COLOR[1]

It is that quality by which we distinguish a light color from a darker one. Color values are loosely called tints and shades but these terms are frequently misapplied. A tint should be a light value; shade—a dark value; but the word shade has become a general term for any type of color so that a shade of yellow may prove to be brighter than a tint of blue.

3. CHROMA IS THE STRENGTH OF COLOR[1]

It is that quality of color by which we distinguish a strong color from a weak one; the degree of departure of a color sensation from that of white or grey; the intensity of a distinctive hue; color intensity. The omission of one of these attributes leaves us in doubt as to the character of each color just as surely as the character of any object would be if we described only two dimensions and left the third to the imagination.

Much of popular misunderstanding of color is caused by ignorance of these dimensions. We also call attention to a paper on nomenclature by L. A. Jones[2] in *Journal of Optical Society of America.*

By the proper juggling of these three dimensions, we strive for a proper balance of color thereby producing something pleasing to the eye. We are actually producing color harmony which is equally true of sound and feeling as in beautiful strains of music or smooth and pleasant-feeling silks and velvets. Roughness and discord register immediately.

Artists, designers and musicians: all strive for this perfect balance and often inject discord into their work in order to draw out the harmonious effect to its greatest value. In our business of coloring, it is a known fact that grey is the easiest color to look at and least fatiguing to the eyes and that smaller areas of bright colors are easier to look at than larger areas. It is easier to match larger samples than smaller samples and less strain upon the eyes than when matching a small strand or a piece of thread.

We mention these facts only as a reminder of the cause and effect of disagreements in color by different individuals.

Now, having these fundamental facts in mind, let us proceed with our discussion and try to explain why a younger man does not see color the same as an older person.

That there is a difference in young and old eyes, there is no doubt and any person working continuously with color, where the old and young are working side by side, must admit there are arguments. Logical conclusions must, of necessity, be reached through an interchange of ideas. That there is a change in color sight between ages of forty-five and fifty has been well proven and I call to your attention or, better still, suggest the following articles be very carefully read:

"Is Textile Work a Strain on the Eyes?" by Dr. Waldemar Schweisheimer.[3]

"Color Matching and What the Dyer Sees" by E. Waters.[4]

"Color Matching and Color Blindness" by W. Garner.[5]

This change in eyesight, I am told by prominent physicians and physiologists, is caused by the lessened elasticity of the eye lens and, as one grows older, particularly one who uses his eyes constantly, finds his eyes soon become fatigued, vision is none too clear, and tears flow readily. During the last fifteen years, I have noticed the effect upon my own eyes.

This is not so noticeable when conditions are identical, such as the same cloth, finish and identical colors, but when a bright surface sample is to be matched upon a mat surface cloth and colors vary, there are bound to be disagreements. There is the effect of luminosity of the fabric as well as different light effects of the colors. This is readily seen when walking from an east to west window where identical colors have not been used.

I might add that, in my opinion, the first look one takes or selection one makes of a match usually is the best.

Illumination is of utmost importance not only for the worker but for the color matcher as well. I do know there are differences of opinion when viewing results from different sources, such as north light or west light. However, if the same samples are tested and viewed under a standard lamp of proper color temperature[6] and if correct distance from the light is observed, we come more into

* Presented at meeting, Northern New England Section, March 16, 1945.

agreement.

I should like to explain a few tests we have been conducting in the Geigy laboratories. During these tests, there have been a dozen of us varying from seventeen to sixty years of age.

Dyeings were made which for designation we have marked K and X. K is dyed with

(Brighter)
.14% Fast Acid Orange 2 G Crystals
.01% Acid Violet 6 B Conc.
.05% Erio Flavine 3 G Supra
.0225% Erio Fast Cyanine S High Conc.

X is dyed with

(Duller) .11% Fast Acid Orange 2 G Crystals
.02% Acid Violet 6 B Conc.
.12% Erio Flavine 3 G Supra
.0125% Erio Fast Cyanine S High Conc.

K being brighter than X.

These two samples are to be matched as closely as possible with the following dyeings marked one to eleven. The chart below gives the per cent proportions of color used (Chart No. 1).

person included in these tests and it is my belief that it does not make any difference whether they are or aren't technically or scientifically minded.

By this chart, it is very easy to see the variations among eleven different people. Inasmuch as Mr. A has proven ability, having been looking at color for over 20 years and having been both a practical dyer and laboratory technician, we have chosen him as a guinea pig to compare with a man about 20 years his senior. In this case, it will be Mr. B. First, suppose we find out how closely they view color.

According to the Glen Colorule, Mr. A chooses dyeing No. 8 to match F while Mr. B chooses dyeing H to match with No. 8. There is only one step between them. Now turn on the artificial light and they both slide the rule to No. 17 and A matches with R while B picks U. In this case, there are two steps between them. Now let us look at our own dyeings of tan. We should, therefore, expect B now to choose a yellower dyeing than A.

As these dyeings shown on the chart are numbered one to eleven, one being the yellowest and eleven the reddest, we will expect B to choose a lower number than A. He does, as A says No. 5 is a little too yellow and B chooses No. 3 as the closest match to dyeing K. Suppose we now compare dyeing X.

To begin with, A does not see such a wide difference between K and X as B does. B chooses No. 2 dyeing to match X while A selects No. 4-5 as No. 4 is a little too yellow for him. When we turn on the artificial light, the violet in K and X comes through. X and K they see almost alike.

These selections were made from tans so we then wondered what would happen if we made these same dyeings heavier. Lack of time, and other work, would not allow to make all eleven so we made every other one; that is, 1-3-5-7-9-11 with K and X also dyed four times heavier.

The final choice of these various groups is shown in the table at the bottom of this page (Chart No. 3).

In this instance, Mr. A picks No. 5 as closest to K while B thinks No. 3 is a little too red. A selects No. 7 as little redder while B picks No. 5 as closest to X. Note how the violet begins to come through in these heavier dyeings. Now let us turn on the artificial light. A chooses No. 6 to match K while B chooses No. 5. The spread is not as noticeable as under the daylight lamp. When looking at X, it has turned so red that they both do not see dyeing No. 11 as red enough.

Naturally, after such a series of tans and browns, we then thought, does this phenomena hold true in all cases; can we solve brightness of fabrics in different eyes. We, therefore, made a series of dyeings of bluegreen. All were dyed by the formulas shown on the following chart. (Chart No. 4, next page.)

CHART NO. 1

Name of Color	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Erio Flavine 3G Supra.....	.2075	.205	.2025	.2	.1975	.195	.1925	.19	.1875	.185	.1825
Erio Floxine 2G Supra.....	.0225	.025	.0275	.03	.0325	.035	.0375	.04	.0425	.045	.0475
Erio Fast Cyanine S High Conc.	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045
Fast Acid Orange 2G Cryst...	.07	.07	.07	.07	.07	.07	.07	.07	.07	.07	.07

CHART NO. 2

Name	*Age*	*Eyes*	*Tech or Non Tech*	*Daylight Mazda F 4 x 20" Tubes*		*Carbon Filament 4 x 32 C.P. Bulbs*		*Glencolorule*	
				Dyeing K	*Dyeing X*	*Dyeing K*	*Dyeing X*	*Mazda F*	*Carbon Fila.*
A	39	Blue	T	5–	4–5	4	6	8F	17R
B	60	Blue	T	3	2	4	6	8H	17U
C	48	Blue	T	4–5	3	4	5–6		
D	37	Blue	T	4–5	4–5	4	6		
E	36	Blue	T	5–6	7	6	11+	12J	20T
F	35	Blue	T	5	3–4	4	5–6		
G	24	Brown	T	3–4	3	4	5		
H	27	Brown	T	4–5	3	4	7		
J	17	Brown	NT	5	4	4	6		
L	34	Blue	T	5–6	5–6	7	11+		
M	36	Hazel	T	5–	3–4	4	6		

The blue and orange remain constant while the yellow decreases progressively —.0025 per cent and the red increases progressively +.0025 per cent. Forty-five seconds were allowed to make the choice. Each person picked independently of the other and, during this test, no one was allowed to know how the other had chosen. We needed some brown-eyed persons but, in looking around our laboratories, we had none among the men so we used ladies. We did not use ladies to differentiate between male and female. The next chart (No. 2) indicates their choice.

In Chart No. 2, the letter T, after color of the eyes, denotes they are technically trained. There is only one non-technical

CHART NO. 3

Brown 4xs Heavy as Tons

Name	*Age*	*Eyes*	*Daylight Mazda F.*		*Carbon Filament*		
			Dyeing K	*Dyeing X*	*Dyeing K*	*Dyeing X*	
A	39	Blue	5	7–	6	11+	T
B	60	Blue	3–	5	5	11+	T
C	48	Blue	3	5	5	11+	T
D	37	Blue	5	7–	6	11+	T
E	36	Blue	6–7	10	10	No Test	T
F	35	Blue	3	5	5	11+	T
L	34	Blue	6	11	11	No Test	T
H	27	Brown	5	6	5	11+	T
J	17	Brown	5	6	5	11+	NT

CHART NO. 4

Name Color	*1B %*	*2B %*	*3B %*	*4B %*
Wool Green S Conc..	.22			
Fast Acid Orange 2 G Cryst.....	.055			
Erio Floxine 2 G Supra	.011			
Novazole Acid Blue BL Supra		.066	.1	.075
Erio Flavine 3 G Supra		.13	.1	.115
Acid Violet 6 B Conc.		.02		.02
Erio Glaucine X High Supra I.....			.01	

In this case, 1B is the control dyeing and is to be matched with 2B-3B or 4B. You will note that 2B has a touch of Erioglaucine X in it. This color, as you know, is a very brilliant greenish-blue.

Note also that in the tan dyeings Mr. E is way off from the rest of us and, in our first dyeings of green, there was nothing brilliant enough to satisfy him. All his choices have been on the red side whether in the tans or browns and, in order to satisfy him, we now had to add this touch of a brilliant blue in dyeing 3B.

The final choice of these various groups is shown in the following table (Chart No. 5):

CHART NO. 5

Name	*Sample Chosen*	*Age*	*Eyes*	*Tech.*
A	4B Yellower-brighter..	39	Blue	T
B	2B Little duller.....	60	Blue	T
C	4B Yellower-brighter..	48	Blue	T
D	4B Yellower-duller....	37	Blue	T
E	3B Little-brighter.....	36	Blue	T
F	4B Little yellower....	35	Blue	T
L	3B Little brighter.....	34	Blue	T

When trying to sum up the various selections of these bluegreens in Chart No. 5, it is more difficult and I am sorry to say less convincing as brightness plays a more important part.

Mr. A selects 4B as yellower and brighter than 1B while Mr. B thinks such a choice ridiculous. Yet, bear in mind, both are selecting what they believe to be as close a match as possible. Mr. B sees 2B as a fair match but a little duller and also thinks Mr. A.'s choice is much too blue. The only explanation we can offer is that, 1B, the standard, is such a brilliant green under artificial light and 2B and 4B turn to such a purplish grey, an agreement here was not possible.

In the case of these greens, the general effct is the same as with tans, except that we were all out of agreement under artificial light and I can make no attempt to reconcile it. We do know, however, Mr. B always sees yellower than Mr. A.

I wonder if we can explain what has taken place in these experiments.

The human body is equipped with a marvelous system of nerves which leads from the central organs of the nervous system to the surface of the body. These nerves are the means through which the eyes, ears, and various other senses communicate with the brain and are known as sensory nerves. Any outside influence which may excite the outer terminity of these nerves sufficiently to cause them to transmit the impression to the brain is called a stimulus and the resulting impression a sensation.

Whenever a ray of light from any source enters the eye, the sensory nerves of the eye become so excited as to transmit the impression made to the brain thereby producing the sensation of light. This sensation produced by light coming from one object is entirely different from the sensation of light coming from another source and the brain is capable of detecting very minute differences between light from one source or another. This ability to discriminate between different kinds of light is known as color perception and the impressions made by different kinds of light are designated as different colors.

Any discussion here of the functions of the human body is beyond the scope of this society and the manner in which light is transmitted from a luminous body to the eye would lead too deeply into the discussion of physics and psycophysics. We can, however, touch briefly on what takes place in the eye.

The eye is probably the most delicate piece of mechanism of the human body. The eyeball is about one inch in diameter and is very delicately set in the orbit of the eye. There are various portions known as the Sclerotic membrane, Cornea, Choroid, Iris, and Retina. We, not being an optical society, may skip over all this and confine ourselves to the Retina.

The Retina of the eye is composed of a vast network of nerves[7], some of rod-shaped and some of cone-shaped ends, and the accepted explanation is that the conical cells receive the sensation of color wheras the rod-shaped cells receive the sensation of light and shade.

There is also in the eye that which is known as the yellow spot. It is the only part of the retina which transmits a clear vision. There is also the blind spot where the optic nerve enters the eye.

Aqueous humor consists of a very weak solution of common salt and lies between the cornea and the lens. I am told that the liquid in the crystalline humor begins to turn yellow and becomes progressively yellower as age increases.

This change has occurred in my own eyesight. I have noticed it often and am only too willing to discuss it.

When I, personally, see a dyeing yellower than a younger person, it is probably due to the fact that the yellow in the crystalline humor of my eye has developed to such an extent that I see most dyeings yellower than the younger person. This has already been demonstrated by the dyeings shown.

I will not touch on color blindness as that is not our subject and is an abnormality anyway.

The younger element here may have little interest today but, twenty years hence, will have to approach these facts. There is no avoiding it anymore than approaching old age.

One may have an abundance of vitality but the eyes do not lie and they are a sure demonstrator that Father Time is doing or has done his work. There is no Fountain of Youth and no Ponce de Leon to search for this Fountain for one.

Before bringing this subject to a close, I would like to take this opportunity to express my appreciation to your Program Committee for extending to me their invitation to be here and, also, my sincere thanks to the other members of your Committee who have so generously given their assistance in helping me to prepare this paper.

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NOTE: The lamp used for viewing these tests consisted of a hooded type shade containing four 24 inch, 20 watt, Mazda fluorescent lamps for daylight and four 32 c. p. carbon filament lamps for artificial light.

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PIGMENT PRINTING AND DYEING

*Past, Present and Future**

ARTHUR McLEAN
Aridye Corp.

THE use of pigments for decorating textile materials has been known for centuries. The Egyptians used pigments, such as ochre and oxides of iron, to brighten drab surfaces. Literature records few details as to the properties exhibited by these early applications. The fact that many were buried beneath the Pyramids may account for the phenomenon that crocking was of little interest, that is, up to 1936. Or perhaps the Egyptians did not carry handkerchiefs for use other than to blow their noses.

A brief glance back over the history of applying pigments shows that a true pioneer spirit must have been present in manufacturers and users. The early trials back in 1936 embraced very few of the advantages now employed in everyday practice.

Before the emulsion system for printing with pigment colors was developed, use of lacquer clears made from nitrocellulose and ethyl cellulose showed that pigments could be printed in very fine patterns, with accurate reproduction of the engravings. On the other hand, this method of applying pigments exhibited a number of weaknesses. For example, the use of volatile solvents made running conditions unpleasant and hazardous. Also, the binders used were found to be soluble in acetone, and shirts which were given a "Trubenized" finish showed bleeding on the collars. This could have meant that pigments were of little use in the shirting field. However, the ability of this type of clear to reproduce fine engravings forced development men to face the weaknesses of the system, instead of merely side-stepping the issue and attempting to find applications where acetone was not used.

The search for suitable binders led to the field of organic thermosetting resins. Upon testing a large number of resins, it was found that a few exhibited excellent stability to all finishing operations and subsequent consumer tests. Unfortunately, the discovery of these resins did not end the bleeding problem, as it was now observed that certain pigments were partially soluble in acetone. A check was made with shirting printers in an effort to establish a line of vat pigments the same as those being used for shirtings. It was found that a number of vat pigments were readily available, but in aqueous dispersions. A study of the new organic resins chosen for their resistance to acetone showed that they were also capable of supporting an emulsion of the water-in-oil type. The aqueous dispersions of pigments were introduced into the organic resin solution with high-speed agitation. Thus an entirely new system or vehicle was discovered. This was the water-in-oil emulsion system.

The new water-in-oil emulsion system showed some of the qualities of being a baby Dr. Jeckyl and Mr. Hyde. The gentle side of its nature exhibited the fine printing qualities of the old lacquer clear. Its excellent color value, plus the introduction of water, resulted in a reduction of cost. These advantages, together with a softening of hand beckoned enthusiasts toward unknown pitfalls. A line of colors was formulated around the new organic resins, and further field trials were scheduled. Some of these early pigment concentrates lost the Dr. Jeckyl attributes and took on those of Mr. Hyde between the time they were capped up in a drum and the time they were opened for use by the printers. Some drums showed the pigment to be hiding in the bottom, others put up a solid front and defied anyone to disturb them with a paddle. Those that showed backwardness in a closely capped drum took the stage in the print machine and proceeded to tarnish the rollers. Finally, as though in satisfaction, they climaxed their performance by breaking the clear. I am sure much of this early ground work taxed the good nature of many a printer, but perhaps conquering the faults and troubles on a run offered sufficient satisfaction for return engagements.

The exchange of knowledge between pigment manufacturers and printers was a valuable guide to the steady progress of pigmented resin emulsions. The constant demand for close color standards and package stability by plants using the system necessitated studies by pigment manufacturers in various fields, such as rheology, collodial, organic, and physical chemistry.

Many of the ventures into these various fields lead back to the fundamental intermediates used in the compounding of the finished colors and clears. The water-in-oil emulsion system survived the plant trial stage; and pigment printing became a valuable adjunct to the conventional systems available to colorists.

However, before the time the new system had an opportunity to get its second wind, cost departments hit it a stunning blow. A few points a yard was all the sustenance print plants received for their efforts, therefore, the voice of the cost departments carried a lot of weight. This might have been a bit discouraging to the pigment manufacturers, but its effect brought forth a realization to pigment suppliers that regardless of whether or not they were offering a new system having advantages, they were competing in the field of coloring textiles; and this embraced a multitude of factors.

Development men were assigned the problem of cost, but with the understanding that anything they might offer must not be at a sacrifice to quality.

An analysis of the problem showed that the low percentage of pigment being offered in pigment concentrates was economically unsound. Also, cut clears requiring high concentrations of expensive resins fell under the axe. The high cost of solvents, such as the rich aromatics, seemed another fertile field in which to cut costs. The correlated research and development on this vital problem brought forth a line of pigment concentrates which although more expensive pound for pound, offered far greater color value. This development permitted longer cuts to obtain a given depth of shade.

A study of clears revealed that certain combinations of resins were compatible. This meant that resins exhibiting strong emulsifying powers could be used with resins with good binding qualities. In reformulating the new pigment concentrates and clears, consideration was given to solubility; and it was found that such solvents as Stoddard or mineral spirits could perform equally as well as high-power solvents. The introduction of these pigment concentrates offering a high color value, the development of new clears, and the use of cheap solvent brought down the cost of pigment printing to a point where

* Presented at meeting, Rhode Island Section, April 27, 1945.

it was competitive with conventional methods. In some cases because of their reliability and ease of application, pigments replaced conventional colors on an equal money value basis.

Progress was rapid, and the amount of pigments used increased many-fold. But with this growth came additional headaches. Some plants venturing into the use of pigments printed large patterns in heavy, dark shades; and crocking was excessive. These disturbed the converters, and in some instances they became suspicious of the new brilliant colors being used by printers. Very soon, however, the progressive plants learned to evaluate patterns in terms of depth of shade and coverage, and turned to the use of pigments with advantage.

One of the most disagreeable problems encountered in the early days was what is referred to as dirt in the colors, but which we technically prefer to classify as grit, as dirt is cheap and this was by no means cheap from the point of view of pigment manufacturers. It seemed that as fast as we eliminated one source of grit several others took its place. When drums became scarce, processors of used drums carefully sand-blasted old drums of their waste content, then proceeded to seal in a goodly quantity of high-grade sand with drum coatings soluble in the solvents used in our pigment concentrates. Finally the problem of grit was suppressed to only spotty occurrences. In some cases we did not have control of the actual manufacture of the pigment, and it was difficult to impress on the manufacturers the seriousness of shipping us particles of ground glass in with the pigment. The only solution was to devise a means of catching all of these impurities before the colors were shipped for use in printing. A few changes in formulation resulted in the establishment of an extra step in processing each color to insure its freedom from grit. This increased processing costs, but paid dividends in nights of peaceful sleep.

This brief recital of the efforts made to overcome the problems met in the early days of printing with pigmented emulsions brings us to the present war period.

THE PRESENT

The incubation of the pad dyeing of plain shades with pigment colors was hardly complete, when the war came. The early work on production of pastel shades on selected fabrics was a weak stepping stone for dark O. D. shades on rugged military fabrics.

Every effort was directed toward adapting pigments to meet government requirements. All systems of dyeing exhibiting good fastness to light and laundering were taxed beyond capacity. Pigments were called upon to do their part. Formulations were worked out which satisfactorily met all specifications. Several million yards of herringbone twill was dyed in an O. D. No. 7 shade which favorably measured up to all standards.

I should like to offer a few exhibits of tests conducted on plant production runs of pigment dyeing in comparison to conventional methods of processing. I am sure you will agree that the pigment applications exhibit equal or better fastness in all respects. Unfortunately, the curtailment of raw material in the resin industry brought this program to a close.

In anticipation of one of your questions it might be wise to discuss briefly the effects of ultra-violet exposure followed by washing on pigment and vat-dyed fabrics. During the production of pigment dyed herringbone twill it was observed that a dyed fabric when exposed in a Fade-Ometer or to direct sunlight exhibited poor resistance to subsequent wash tests. Although this was a serious weakness, a comparison with vat-dyed fabrics showed it was not a problem for pigment manufacturers alone. All available manpower was shifted to the problem, and the weakness was corrected without a hitch in production. However, the elimination of the offending materials did not answer or explain what actually took place. The problem was shifted to fundamental research men, and an extensive program of study was laid out.

Although the curtailment of raw materials has undoubtedly retarded the development of pigment padding, a number of fundamental problems and principles have been dealt with, and much valuable experience has been gained.

Pigment dyeing, more so than any other form of dyeing, must be right when first applied. When thoroughly dry, the resin binders are not affected by ordinary stripping agents and pigments cannot be bleached of their color.

To discuss briefly the steps involved in pigment dyeing, it is worth-while to consider mixing equipment. The formation of a weak emulsion will give trouble before many yards have been processed. An inadequate mixer does not make full use of the stable emulsifying qualities built into the clear and pigment concentrates. A physical operation is all that is required of a mixer. In the case of a water-in-oil emulsion the water is the discontinuous phase, thus the water must be broken down into as small globules as possible. The more thoroughly this is done, the better the resulting emulsion. The degree of emulsification can have the following affects: a poor emulsion does not afford a proper diluent for the cutting of pigment concentrates. If the pigment is not thoroughly dispersed throughout, specking of the color may be evident. The degree of emulsification also greatly affects the color value obtained or control of the final deposition of the pigment to the fabric. If an emulsion breaks water in the pad box, these drops of water will act as resists in the dyed fabric. The types of mixer most frequently used are the Eppenbach, High-Speed Lightning, and Lawrence Pump. All do a satisfactory job when operating efficiently.

The second step in the operation is the application of the color to the fabric through the use of a padder. Pigments, as you all know, are inert coloring materials—that is they do not exhibit affinity for any of the materials used for textile purposes. This is to your advantage, as danger of selective exhaustion in a padding liquor does not exist. Shade matches will not tail off in cast or depth of color from start to finish of a run. The padding operation is a metering on of pigment coloring material in an emulsion vehicle. If this operation is not even from selvage to selvage, or if rolls have imperfections in them, all will be evident in the finished fabric. It is recommended that pad rolls be covered with materials resistant to the action of solvents. Hycar has worked very satisfactorily for this purpose; otherwise standard equipment is suitable to perform this operation. It is impossible to be specific as to the number of dips and nips a padder should have, as fabric constructions and weights are the governing factors. However, due to the fact that solvent is the outer phase in a water-in-oil emulsion, thorough wetting takes place almost immediately—even on heavy fabrics. The amount of set to be run is again governed by the fabric weight and construction. The application of an excessive amount of material should be avoided, as drying is slowed down and migration is more difficult to control.

The next step in a dyeing operation has considerable influence on the end results. We have classified this as pre-drying, which consists of removing anywhere from 60 to 85 per cent of the moisture and solvent from the fabric. Keeping in mind the physical structure of the pigmented resin emulsion we have just applied to the fabric, let us theorize on what takes place in the pre-drying operation. Pigments are inert and will come to rest on the fabric where and when we cease to exert pressure of a physical nature. If we subject the wet fabric to a sudden blast of hot air from one direction only, we cause evaporation to take place far

more rapidly than on the other side. And as the pigment is probably still controlled by the vehicle or medium in which it is applied, it migrates to that side of the fabric.

If we balance the flow of air on both sides of the fabric, but still maintain a high degree of heat, it is quite probable that we cause the low-boiling solvent to boil violently within the fabric before sufficient exchange of air takes place to remove it. Here again we are disturbing the even deposition of color we so carefully applied in the padding operation. Under these circumstances some pigments would have a tendency to flocculate and in so doing would impair the fastness and the appearance.

It seems logical, therefore, to attempt to ascertain an optimum temperature at which the rate of evaporation will be gentle and even. This will vary considerably, depending on the type of fabric being processed.

The major requirements for this pre-dryer are a balanced flow of air, and good ventilation capacities to remove solvent and moisture vapors. An air exchange of 10,000 cubic feet of air for each gallon of solvent evaporated is the recommended minimum by the Underwriters Laboratories for safe conditions of operation. Naturally open flames cannot be used in this area of operation. In some cases ordinary dry cans equipped with accurate temperature controls have been used to perform the pre-drying, and still other units are so arranged that tenter frames serve as pre-drying units. However, these must be carefully controlled or clip marks will result where contact is made on the wet fabric.

The final operations consist of thoroughly drying the fabric on any suitable equipment, then subjecting it to high temperature curing from 350° to 400° F. for a period of from one to three minutes. Temperatures low as 300° to 320° F. may be used, and satisfactory fastness results obtained if a longer period of time is allowed. The governing factor is the ultimate fabric temperature, so it can be seen a wide range of temperatures can be used.

Although pigment padding has been the major point of interest in the present era, I feel there has been numerous applications in various mediums such as alkali soluble cellulose, modified starch, water and solvent which have added a great deal to the general background of pigment manufacturers and users.

The processing of flameproof duck and camouflage burlap are far removed from the coloring of women's dress fabrics. However, the dispersing of pigments for each is in many ways alike. Processors, on the other hand, have developed safe methods for the handling of solvents and mixing procedures have been reduced to routine practice.

Before passing on to the future I would like to discuss briefly an interesting printing application which does not center around pigments, but around water-in-oil emulsion; that is the use of water-in-oil emulsion as a vehicle for soluble dyes. Fabrics and styles sometimes present difficult printing problems. Faced, heavy drapery fabrics requiring blotch printing are at times difficult to print and obtain a sound, well penetrated appearance. The use of chrome colors carried in the water phase of the emulsion has given excellent results. Light rayon dress goods have been blotch printed with directs, basics, and other fugitive dyes with uniformity and such good penetration it is difficult to distinguish them from prints made on dyed grounds.

The softness of hand obtained with an emulsion vehicle eliminates the danger of breaking or cracking light weight fabrics, such as Bembergs. A further point of advantage is the decrease in bleeding in subsequent soaping operations. This is explainable as the solids are very low in the clear emulsion, allowing maximum fixation of the dyestuff during ageing.

The Aquadye system of applying dyes does not alter the fastness of the dyestuff used in any respect. Dyes such as Rapidogens and Indigosols must be printed with the necessary developing agents. The after-treatment by ageing or wet developing is the same as with conventional gums.

THE FUTURE

It is difficult to perceive what the future of pigments will be: an inventory therefore would be in order. Under the heading of assets we have:

First: a number of pigments exhibiting excellent resistance to sunlight.

Second: a complete range of colors with some displaying permanent brilliancy unsurpassed by any other type of coloring component.

Third: a complete range of colors having inert properties which build for more carefully controlled processing.

Fourth: a printing vehicle capable of accurately reproducing the finest engravings.

Fifth: rein binders resistant to all consumer tests also exhibit softness of hand insuring safe processing of the most delicate of fabrics.

On the other side of the ledger under the liability column we note:

First: excessive crocking in dark heavy shades.

Second: that certain pigments and binders are affected by discharge agents.

Third: the necessity for high-temperature curing where maximum fastness to washing is required. In striking a trial balance of the above assets and liabilities the future of pigments gives promise for considerable expansion.

Recent research and development have revealed forward steps in overcoming or reducing the drawbacks to a point where it is reasonable to assume that we would or could do with pigments without these restrictions.

If a complete line of pigments were available which would satisfactorily withstand discharge agents this would mean the use of brilliant peg colors fast to light and washing on various types of rayon dress goods and sportswear.

To lift the crocking ban on heavy shades would require another evening's discussion, possibly extending until the wee hours of dawn. However, improvements can be foreseen which will affect the economy and printing of many a pattern, beyond the scope of pigments as we have known them in the past.

The cutting down or elimination of high-temperature curing will be governed by future releases in the field of organic resins. You are all well aware of the tremendous amount of activity in this field. However, as this has never been a major obstacle in the development of pigments I feel it is better to dwell on more critical problems. The exception to this would be in the woolen and worsted field where exposure to high temperatures causes severe degradation of the fibers.

When the gates are opened the textile field is due to be flooded with torrents of synthetic fibers, fabrics and films. In anticipation of these releases, clears and pigments have been formulated which will satisfactorily adhere to such materials as Vinylite, Saran, Vinyon, Koroseal, and the rapidly growing natural fiber, Fiberglas.

The radical chemical difference in many of the new fibers and yarns have already presented difficult problems to printers and dyers. Some of these materials have been practically impossible to dye due to their low substantive properties. In some cases dyeing has been carried on with a limited range of colors, many of which are of a fugitive nature—thus the inherent advantages of the new fibers and yarns have a limited scope. Experimental work conducted to date with many of these new fibers and films has revealed that the desirable attributes of pigmented emulsions are carried over from cotton and rayon processing. The physical properties of many of the new synthetics have presented

unique application problems. Fabrics of Fiberglas yarn when thoroughly scoured of their sizing materials are difficult to wet out with conventional aqueous systems. The ability of a water-in-oil emulsion to thoroughly wet non-absorbent surfaces insures even and uniform printing and dyeing. Synthetic thermoplastic yarns and films, some of which undergo critical changes at temperatures as low as 180° F. have necessitated the use of low-boiling solvents. Fiberglas on the other hand, with its low heat conductivity fails to present migration problems often encountered with the use of pigmented resin emulsions. Pre-drying operations have been carried out on ordinary dry cans without disturbing the even deposition of color.

Experimental work conducted in the field of synthetics is fascinating, yet it is my feeling that cotton will remain the major item to be printed and dyed.

A glance over the research and development in the field of cotton reveals that much progress has been made, despite the attention focused on synthetics at the present time. Resistance to abrasion, soiling and ordinary wear of cotton fabrics has been improved to a fine degree. It is imperative that coloring materials used on service fabrics such as work and sport clothes, dress goods, shirtings, etc. be printed or dyed with colors that will last the life-time of the base fabrics. The factors necessary to meet these stringent requirements are found in pigmented resin emulsions.

The progress made in the last few years in the application of pigment colors to textiles has been due largely to the close cooperation between the manufacturers of pigment colors and the printers and dyers. The working out of the many problems which have arisen has caused many headaches. Without doubt, other problems will arise as the use of pigment colors is extended into unfamiliar fields. However, the manufacturers of pigment colors have learned a little about the textile industry; and the printers and dyers have learned a great deal about the proper handling of pigment colors. Working together, they should be able to solve these new problems with somewhat fewer headaches than in the past.

DISCUSSION

Q.—You stated that satisfactory service fabrics can be produced with pigmented resin emulsions. Now we have been led to think that the way to color fabrics is to thoroughly penetrate each fiber with (vat) dyestuffs diffused throughout the fiber; and I mean the fiber, not the yarn, so that you get a maximum fastness and a maximum service. How far penetrated are the pigmented resin emulsions? or are the resin films only on the surface? and are they equal to the life of the fibers?

A.—The fixation of pigment to the fabric is accomplished by the use of thermo-setting resins, as the pigment is physically bonded to the yarn or fibers by these resins. It is, therefore, essential that they must withstand severe abrasions, washing, and exposure to light. Actual tests show there are a number of resins, if properly applied, that will withstand the tests mentioned equally as well as the cotton itself. Experience to date on work clothes' fabrics indicate that resins actually lengthen the wear of the cotton.

Q.—Then am I to understand that the pigment is carried in the resin film and that the resin films are on the surface of the fibers to be colored?

A.—I would not say that the pigments are deposited on the surface of the fabric only. Pigmented-resin emulsions of the water-in-oil type show excellent penetration. When observed with the naked eye the penetrations appears to equal that of a vat-dyed fabric. However, photomicrographs of a yarn cross-section show the color to be on the surface of the fibers, and thoroughly penetrated throughout the yarns.

Q.—You stated that in dyeing Fiberglas with pigments there is no danger of migration. Would you like to enlarge on this a bit? I think it is self-evident that when you progress from Fiberglas to nylon to cotton, the difficulties of migration are apt to increase rather than otherwise.

A.—The problem of migration, as previously stated, can be minimized by careful control of the pre-drying operation. Satisfactory paddings on Fiberglas have been made by padding and drying on ordinary dry cans. This procedure generally yields considerable migration on cotton fabrics. It is believed that the low-heat conductivity of glass may be a factor.

Q.—Is Fiberglas the only fabric where you get low migration?

A.—Fiberglas exhibits the least amount of migration of any of the fabrics padded to date, however, synthetics such as nylon, high-tenacity rayon, etc. give little trouble during drying. This is possibly due to their low moisture adsorption.

Q.—Are dispersing agents of value to prevent pigment flocculation?

A.—Dispersing agents may be used to assist in deflocculating pigments. However, care must be taken that the emulsion does not reverse.

KNOW THIS EMBLEM

The lapel emblem worn by men honorably discharged from the armed forces. It stands for honorable service to our country.

CALENDAR OF COMING EVENTS

Meetings, Council and Research Committee, Hotel Commodore, New York City, October 5, 1945. Chairmen of Sub-Committees who wish to hold meetings on October 4th at the Hotel Commodore should notify Dr. Louis A. Olney.

Meeting, New York Section, Downtown Athletic Club, New York City, October 5, 1945.

Meeting, Rhode Island Section, October 26, 1945.

NOTICE TO SECRETARIES OF LOCAL SECTIONS:

Please advise the National Secretary or the American Dyestuff Reporter of your meeting dates for the 1945-1946 season as soon as available.

DYEING MANUFACTURED FIBERS MANUFACTURED FIBERS

(Continued from Page 306)

amounts of blue and other shading colors may be added on the jig for shade correction. After dyeing and rinsing with warm water, the cloth should be made slightly alkaline with a weak solution of soda ash. This process yields very even shades from selvage to center and is a great time saver. Viscose and acetate mixtures require a highly soluble direct dyestuff for the viscose component. This method permits production of shades highly resistant to atmospheric fume fading, crocking and washing.

Consideration of the end use of fabrics is also important on qualities that are box dyed, for example, ladies' dress goods. Here also, fume fastness is more important than light fastness. A striking proof of this is the fact that millions of yards of dress fabrics have been dyed with dianisidine base and coupled with beta-oxy-naphthoic acid to produce a bright navy. Fabrics dyed in this manner have excellent resistance to atmospheric fume fading but show a noticeable fading when exposed to three hours on the Fade-Ometer. Obviously a greater margin of safety on light fastness is desirable despite the fact that this navy appears to be acceptable to the consumer.

Some dress constructions can be dyed at high temperatures with the azo blues. Others, such as fabrics of alpaca and romaine types, which are constructed with combination yarns containing crepe twist viscose as one component, do not permit processing at temperatures exceeding 175° F. Since the azo blue dyestuffs have a tendency to surface-dye at low temperatures, it is important to use a combination of an anthraquinone blue dyestuff having the best available fastness to atmospheric fume fading, with the fume resistant azo blues. A 60-40 mixture of Eastone Blue BGF with Celliton Fast Blue AF (Pr. 227) dyed on as a base, with all further shading done with the Blue AF, is giving satisfactory results in many plants. For maximum protection, after dyeing with the above combination of dyestuffs, a suitable protecting agent is added either to the rinse water or in the final finishing operation. Fabrics processed in this way are fairly fast to light and fume fading even after a number of dry cleanings or washings. For dress fabrics, constructed of either filament or spun yarns, which demand brilliancy of shade, suppleness of hand, and the maximum degree of shrinkage in processing combined with the maximum degree of resistance to light, fume fading, crocking, and dry cleaning, a fairly large group of cellulose acetate colors is available. These fabrics do not lend themselves to dyeing with vat colors by known methods which involve processing under tension because of the injurious effect on hand and dimensional stability.

For the dyeing of light and medium shades on dress goods, the following dyes (and similar types offered by the various dye manufacturers) have been found highly resistant to both light and fume fading when correctly applied:

Celliton Fast Blue AF (Pr. 227)
Celanthrene Fast Yellow GL
SRA Golden Yellow FSI
Eastman Fast Yellow GLF
SRA Red 6X
SRA Light Orange FSI
SRA Golden Orange 111
Eastman Fast Yellow 4RLF

The following types have been found exceptionally fast to light but somewhat less fast in gas resistance:

Celliton Fast Blue FFG
Celliton Fast Pink BA (Pr. 234)
Celliton Fast Blue Green B
Celliton Fast Violet BA (Pr. 240)
Eastman Fast Violet 5RLF
SRA Violet FSI
SRA Red FSI

Since each manufacturer of dyestuffs uses a different type of dispersing agent, the dyestuffs of the various companies should be dispersed separately before adding to the dye bath. It is ordinarily desirable to use a small amount of soda ash in the dye bath. Fabrics dyed with 0.025 per cent of soda ash on the weight of the dye bath, in combination with soap or the various fatty alcohols, are slightly faster to atmospheric fume fading than those dyed in a neutral bath. However, all forms of alkalis should be avoided when dyeing the azo blues.

Fabrics which have been finished with synthetic resin, where acid or acid-forming salts have been used, or are formed during curing, must be washed well after curing and left on the alkaline side, preferably by the addition of a small amount of soda ash to the rinse water.

A suitable fume-protective agent should be incorporated in the finish when fabrcis are dyed with even the best anthraquinone blues such as Celliton Fast Blue AF (Pr. 227).

The advantage of selecting a group of the better type of acetate dyestuffs and planning the dyeing and finishing operations to obtain the best possible light and fume fastness is that these selected anthraquinone dyestuffs when properly applied are from two to three times more resistant to atmospheric gas fading than the ordinary types of anthraquinone on the market at the present time. Since colors which are affected by atmospheric fumes go through a period of incubation, or induction, prior to any noticeable change in color, the dyes which show the greatest resistance without any protectives agent should be selected.

We have found by exposure of fabrics in the fume fading chamber that the pH of most textile fibers is lowered by exposure to atmospheric fumes. Since the effectiveness of the protective agents is nullified at a pH below 7 and the fume fading of the dye itself is increased if the fabric is on the acid side, the importance of finishing the fabric to a pH of 8½ to 9½ is evident.

According to C. A. Seibert,[4] a fabric which shows no objectionable change when tested according to the test procedure of the American Association of Textile Chemists and Colorists using their recommended test dyeing Number One as a standard, will show no objectionable fading when used under normal conditions for periods ranging from nine to twelve months. After studying the case history of several fabrics produced and marketed on a substantial scale, which were dyed with a selected group of anthraquinone dyestuffs and properly protected against storage fading, we have found that claims and rejects have been practically eliminated.

Several factors have to be taken into consideration in the selection and evaluation of protective agents for dyed acetate fabrics. For example, some protective agents give good protection against fume fading but affect the shade and the light fastness of most viscose direct colors. These products may be used satisfactorily on fabrics dyed only with acetate dyes. The following points should be considered in choosing the proper chemicals as protective agents:

1. Maximum protection against fume fading.
2. Resistance to washing and dry cleaning.
3. Change of shade of either viscose or acetate dyestuffs.
4. Effect on light fastness of viscose direct colors.
5. Effect on the hand of the fabric.
6. Ease of application.

The following amines, when applied to a dyed fabric which has been rinsed in an alkaline bath, will give good protection against atmospheric fume fading:

monoethanolamine
diethanolamine
triethanolamine
beta-hydroxyl-ethyl ethylene diamine
melamine[5]

Each of these products has somewhat different properties when used as a protective agent on all-acetate fabrics and mixtures containing viscose.

All of these chemicals except melamine affect the light fastness of most viscose direct colors. Tests for change of shade and of light fastness were carried out by padding swatches of a dull viscose fabric, which were first dyed with the direct colors, in an alkaline bath with a one per cent solution of the various amines, the squeeze being adjusted to allow a 75 per cent pick-up of the padding liquor. The swatches were dried for five minutes at 300° F. A portion of the treated swatch was then exposed in the fume fading apparatus and another portion in the Fade-Ometer.

Beta-hydroxyl-ethyl ethylene diamine is outstanding as a protective agent, but it affects the shade of many direct viscose dyes and reduces the light fastness of these dyes to such an extent that it is not recommended for fabrics containing fibers other than acetate rayon.

Monoethanolamine affects the shade of practically all viscose dyestuffs to the same extent as beta-hydroxyl-ethyl ethylene diamine.

Triethanolamine does not change the shade of most viscose dyestuffs, but it affects their light fastness as much as or more than beta-hydroxyl-ethyl ethylene diamine, particularly when applied to dull viscose rayon.

Diethanolamine does not change the shade of many direct colors and has a minimum effect on the light fastness of most direct colors.

The above amines are not readily removed by drycleaning unless wet cleaning is used in connection with the operation.

Melamine, being one of the most insoluble amines and possessing some affinity for cellulose acetate, is more resistant to drycleaning and washing than most amines. Due to its low solubility in water at ordinary temperatures, it is the most difficult to apply. Approximately one per cent of melamine is soluble in water at a temperature of 100° F., providing the melamine is added to boiling water and allowed to cool slowly. For maximum protection, the cloth as it enters the drier should retain approximately seventy to one hundred per cent of its dry weight of a one and one-half per cent solution of melamine, applied at 140° to 150° F. Exceptionally good results have been obtained by applying the melamine on a regular dye padder and drying in the drier.

A typical formula for a 50/50 spun acetate and viscose fabric is as follows:

1½ pounds of melamine are pasted up with 1 pound of diethanolamine and dissolved with 50 pounds of boiling water. After complete solution is obtained, this is added to a finish composed of 1½ pounds of an anion softener and 49 pounds of hot water at 160° F.

This solution is applied by immersion of the box-dyed material on a dye padder at 140° to 150° F., adjusting the squeeze on the pad rollers to allow a pick-up of from 70 to 100 per cent, based on the dry weight of the fabric. The padded fabric is immediately dried in a continuous air drier.

The same general formula and method of application may be used for fabrics which have been jig-dyed. The finish may be applied by installing closed-coil heating units in the pan of a regular two-mangle quetsch so that the temperature can be maintained between 140° to 150° F. at all times.

Fabrics dyed with Celliton Fast Blue AF, (Pr. 227) rinsed in an alkaline bath, and finished with the above type of protective finishes, show no appreciable fading after two A.A.T.C.C. standard gas tests. After washing at 120° F. for ten minutes in a Launder-Ometer, the fabrics show only a slight change of self-fading when exposed to one standard A.A.T.C.C. gas fading test.

For those constructions which will not withstand any pressure treatment such as padding or mangling, the fabric should be extracted after dyeing and passed through a 2 per cent solution of diethanolamine, then vacuum extracted and dried.

Experimental work is in progress on relatively new fume protective agents for acetate rayon in an effort to develop agents which will be resistant not only to drycleaning, but also to ordinary laundering.

Dyed shades that fume-fade to a self-tone or to a slightly greener shade are always more acceptable than those which fade red. Some dyers are applying this principle in the selection of dyestuffs to obtain a more acceptable result for certain fabric uses. For example, the type of anthraquinone blues represented by Celliton Blue GA Extra (Pr. 225) or Celliton Blue BB, which fume-fade first to a slightly greener cast and then fade progressively weaker without much further change of cast, is less objectionable than the type of anthraquinone blue that fades immediately to a red-violet shade.

The installation of a fume fading apparatus in a dyeing plant permits it to check every lot of finished goods. This not only provides evidence of the resistance of the finished fabrics, but also a wealth of firsthand information on which to base improvement of quality with respect to fume fastness. Such data will demonstrate to the customer the returns in terms of fume fastness which he gets for the increased price in dyeing with the better types of acetate dyestuffs. It is obviously unfair from both the quality and the cost standpoints to compare finishing prices based on the cheapest type of dyestuffs and processing without regard to fastness with prices based on the selection of better dyestuffs applied under competent technical supervision.

Fast Color Dyeing of Cellulose Acetate

Cellulose acetate fibers may be dyed by a selected group of acid colors when these are applied by the use of various swelling agents. A considerable amount of skein dyeing has been done in the past using a 75 per cent solution of alcohol. Recently a process has been developed using a 30 per cent formic acid solution alone or in combination with other acids. This process has proved successful—particularly for skein and package dyeing.

Another process utilizes the swelling action of zinc thiocyanate. A general formula is as follows:

½ pound Wool Fast Blue BL (C.I. 20)
is pasted with
½ pound Cellosolve and dissolved with
24 pounds of boiling water — then
added to a solution containing
1 pound acetic acid 56 per cent
30 pounds zinc thiocyanate solution—
33⅓ per cent by weight
45 pounds water
⅛ pound Igepon T

The skeins are dyed at 140° F. for one half hour, rinsed, and scoured with Igepon T and soda ash at 160° F.

The following acid colors have been recommended for this type of dyeing:

Polar Yellow G conc. (C.I. 642)
Wool Fast Blue BL conc. (C.I. 833)
Patent Blue A—160 per cent (C.I. 71)
Neutral Brown RX
Patent Blue V (C.I. 712)
Alizarine Cyanine Green GX (C.I. 107)
Wool Fast Blue GL conc. (C.I. 833)
Polar Red B conc. (C.I. 430)
Alizarine Sky Blue B (C.I. 1088)
Alizarine Irisol RD (C.I. 1073)
Amido Yellow EA CF (C.I. 11)
Anthralan Red BA CF (Pr. 210)

Low concentrations of dyestuffs may be used and fairly good exhaustion is obtained when the zinc thiocyanate is employed. The dyebath should be saved and used over and over again, since the thiocyanate is non-volatile. An advantage of this method is that no objectionable odors are given off during dyeing.

Raw stock, skeins, and packages may be dyed by these various swelling methods resulting in dyeings which are highly resistant to gas fading, peroxide bleaching, washing, light and cross-dyeing.

Considerable attention has been paid to the dyeing of acetate rayon with vat colors. A great deal of difficulty has been experienced in the past in applying the fast-to-light types of anthraquinone vat dyes

due to an excessive saponification of the cellulose fibers. Some of the processes have used the indigoid type of vat colors which dye cellulose acetate fairly well without undue saponification of the acetate. However, with mixed fabrics containing cotton and viscose, the latter fibers are left practically unstained.

Spun fabrics containing less than 30 per cent cellulose acetate have been dyed successfully in light shades by a partial saponification of the acetate fibers. This method of dyeing is carried out by padding the scoured material at room temperatures with a padding solution containing a vat dye, 20 per cent alcohol, a small amount of Gum Karaya and a non-foaming wetting agent. After padding, the vat dyestuff is then reduced on either a jig or other suitable apparatus in a reducing medium containing trisodium phosphate and sodium hydrosulfite. By a careful selection of vat dyestuffs, temperature control and reducing the time factor to a minimum, good results have been obtained in light shades.

Vat colors may be applied successfully to an all-acetate fabric by first swelling the fabric with 2 per cent salicylic acid (on the weight of the fabric), drying at a low temperature without undue tension, and applying a selected group of vat dyestuffs by the pigment pad method. The reduction is carried out on the jig, utilizing ethylene diamine and ammonia alone or in combination with triethanolamine as the alkali and sodium hydrosulfite as the reducing agent. The acetate rayon is only slightly surface saponified.

Some time ago, the Tennessee Eastman Corporation originated a special vat dyeing process which has been further developed jointly by Tennessee Eastman and the Joseph Bancroft and Sons Company.

By this process all-acetate rayon fabrics or fabrics containing cellulose acetate in conjunction with natural or regenerated cellulose fibers may be dyed with all types of vat dyes in such a way that solid shades are produced on combination fabrics as well as on all-acetate fabrics.

Patent applications have been filed by the Tennessee Eastman Corporation upon the original discovery, and by the Joseph Bancroft & Sons Company upon process modification and improved mechanical equipment used in the application of this dyeing procedure.

Since high molecular weight anthraquinone vat dyes may be applied by this method, it is possible to obtain all the valuable durable properties inherent in this type of dyestuff, retaining at the same time the excellent stabilizing properties and the characteristic hand and feel of cellulose acetate, thus resulting in a fabric of superior physical properties.

The development of this process is being done by the Brancroft Company with the technical assistance of the Tennessee Eastman Corporation. The process has been worked out in a practical way on certain types of weaves and in a certain range of colors. It is planned not to divulge the process or its state of development until a full range of shades as well as a wide range of weaves has been produced in practical runs. At the moment, it is impossible to estimate when this work will be completed. When announced, it is intended to make the process available (through a nominal licensing arrangement) to any concerns interested in producing goods in accordance with this discovery, to whom will be furnished the necessary technical assistance for installation and production of the process. This process will not be confined to fabrics containing Eastman acetate rayons but will be available for any acetate fabrics because Eastman feels that, through its wide application, the superior fastness qualities of vat dyes will broaden the field for acetate rayon.

THE DYEING OF NYLON

Nylon is more subject to permanent creasing during the scouring and dyeing operations than other fibers, unless the fabrics are first subjected to a pre-setting operation. Pre-setting should be carried out at least 50° F. higher than any ensuing wet process. Special attention must be given to the selection of fugitive tints and to cleanliness during the setting operation. Some tints and any foreign substances are likely to be absorbed by the softened material and it is then practically impossible to remove them during scouring.

Several procedures have been suggested for the pre-setting of nylon fabrics. These have included (1) setting and dyeing on an enclosed jig at 205° to 210° F. for two to four hours; (2) steaming under pressure in a special steaming apparatus;[7] (3) first wetting out and drying on a palmer tenter unit, utilizing the highest steam pressure possible on the palmer cylinder and a special palmer blanket constructed with copper wire and asbestos; and (4) aging in an ordinary hydrosulfite print ager at 220° F. from five to ten minutes.

Experimental work is being carried cut on a high speed continuous steaming apparatus combining the principles of a loop drier and an ager. The cloth is folded by mechanical means in a series of loops on revolving sticks which move forward through a humid, steam atmosphere at temperatures ranging from 212° to 220° F. No undue tension is applied at any time during the operation.

After pre-setting, nylon fabrics may be boiled-off or scoured in the same manner as previously described for acetate rayon fabrics. If desired, bleaching may be carried out by the conventional permanganate-sulfuric acid and bisulfite method commonly employed for cellulose acetate. On certain types of fabrics of very dense construction, it is desirable to give an additional treatment in a one per cent solution of soluble zinc formaldehyde sulfoxylate at 180° to 190° F. for twenty minutes.

Selection of Dyestuffs

Due to its protein-like structure, nylon has an affinity for all classes of dyestuffs which are generally associated with the dyeing of silk and wool.[8] The report of the War Production Board Task Committee mentions that any of the direct acid and chrome dyestuffs which have an excellent affinity for nylon when applied by the conventional methods used in the past, accentuate the weaving defects which are caused by the inevitable difference in orientation of nylon yarns due to variations in denier and draw-ratio of the highly oriented fiber. This report states that these types of colors may be applied successfully by various padding methods involving, in some cases, a steaming operation.

Acetate dyestuffs have been found to give the best all-round results for brightness and levelness of shades. These dyes may be toned or shaded with a suitable group of acid colors. By a careful selection of acetate dyestuffs, fastness to both light and washing may be obtained which is comparable to that of acetate rayon fabrics dyed with a selected group of acetate colors.

Some of the acetate dyestuffs which are only fairly resistant to sunlight when dyed on acetate rayon fabrics are classified among the best for light fastness on nylon. For example, Celliton Fast Yellow GA is moderately fast to sunlight when dyed on acetate rayon; when dyed on nylon, however, it is highly resistant to light fading.

Amino or alkylamino anthraquinone acetate blues which fume fade when dyed on cellulose acetate fabrics are more resistant to this type of fading when dyed on nylon fibers. However, several of these dyestuffs show a marked fading when dyed on nylon in light shades and when exposed to two A.A.T.C.C. gas fading tests at 140° F.

Chrome and pre-metallized colors yield shades on nylon which are considerably faster to both light and washing than the same shades obtainable with acetate dyestuffs. However, these types of colors are difficult to level and accentuate warp streaks and other construction defects.

Just recently, (January 19, 1945) the War Production Board and the U. S. Quartermaster General released a bulletin referred to previously, entitled "Report of W.P.B. Task Committee on Dyeing of Nylon in O.D. No. 7 Shade." This contains a resumé of recent work in applying acid, chrome, and metallized dyes on nylon fibers. It is advisable for anyone interested in this particular field to review this report.

DYEING OF CASEIN FIBER

Casein fiber is made from a protein base. Due to its low wet strength, it is used at the present time only in combination with other fibers. It is readily damaged by alkalis, even in dilute concentrations. Fabrics containing casein fiber should not be processed at a pH higher than 7.5. Casein fibers have an affinity for almost all classes of dyestuffs which are applicable at pH's below 7.5. This fiber is generally dyed with acid dyes by methods used for wool. A selected group of direct colors may be applied to cross-dye mixtures of casein fiber and viscose rayon by the addition in the dyebath of di-sodium phosphate, and by carefully controlling the pH. Dyeings carried out in this manner leave casein fibers practically unstained. Many viscose-casein fiber combinations are being dyed at the present time by selecting a group of direct colors which dye both the viscose and casein fibers and topping the casein fibers with neutral dyeing acid colors which do not stain viscose. Acetate dyestuffs dye casein fibers to a limited extent but result in dyeings which are poor in resistance to both light and washing.

A selected group of the metallized acid colors may be applied to casein fibers by the conventional methods applicable to wool dyeing. Fabrics dyed with these dyestuffs are highly resistant to light, perspiration, and washing.

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TRADE NOTES • NEW PRODUCTS

• ELECTED AMECCO VICE-PRESIDENT

Walter E. Scheer has been elected Vice-President and a member of the Board of Directors of Amecco Chemicals, Inc.,

Walter E. Scheer

manufacturers of synthetic organic chemicals in Rochester, N. Y. Mr. Scheer, who has been General Sales Manager for the past several years, will continue to make his headquarters in the company's New York office at 60 E. 42nd Street.

• DATA ON ALKAPENS

Burkart-Schier Chemical Company, Chattanooga, Tenn., has issued a Technical Data Sheet on the Alkapens, a complete series of mercerizing assistants. Some of the Alkapens show good wetting properties over a wide range of caustic concentrations while others show optimum wetting in caustic of a particular strength. These differences are indicated on the sheet. The Alkapens available are identified as follows: AA, B, PH, 48, B-40, RPF, WS. Copies of the Data Sheet are available upon request as well as a convenient pocket rule having a table for ready conversion from Twaddle scales to either specific gravity or Baume scales. Burkart-Schier can also furnish a data sheet describing the preferred methods of handling and dispensing mercerizing assistants in your plant.

• JOINS RUMFORD CHEMICAL

Appointment of Dr. Raymond L. Copson, formerly chief of chemical research and engineering for the Tennessee Valley Authority at Muscle Shoals, to be director of research for Rumford Chemical Works, is announced by Rumford's President, Albert E. Marshall.

For 12 years with TVA Dr. Copson engaged in research and development principally in the production and uses of phosphorus and its compounds, and ammonia and ammonium nitrate. At Rumford, where the first American production of phosphoric acid was undertaken in 1858, he will direct research on phosphates and the company's other chemical products.

• REJOINS IMPREGNOLE

Honorably discharged after two years in the army, most of which time was spent overseas in the Italian Campaign, Bernard J. Miller has rejoined the Impregnole Corporation, subsidiary of Warwick Chemical Company. Edward F. Stark, General Manager of the Impregnole Corporation, announced that Mr. Miller was returning in the capacity of his assistant. In addition, he would be in charge of promotional activities in the woolen field, relative to the sale and application of Impregnole, Norane, Dura-Lana and other Warwick products.

We are indebted for this photograph (a little the worse for wear) to Daniel P. Knowland of Geigy Co., Inc.

It shows a group of students and instructors at the Lowell Textile Institute, posed in back of Southwick Hall. The photo was taken in 1906.

Mr. Knowland has identified the persons as follows:

In doorway: Newcomb, '06, Fleming, '06, Whitman. '06, Brookhouse, '06.

Second row: Hoyt, '07, Raymond, '07, Robertson, '07, Lee, '07, Knowland, '07, Taylor, Hayes, '07, Shea, '07, Cole, '05, J. B. Reed, instructor in qualitative chemistry, Prof. Louis A. Olney, Hadley, '06.

First row: Bicknell, '07, Eames, '07, Stott, '07, Craig, '07, Farmer, '07, Hawthorne, '07, Ellis, '07, Schwarz, instructor in dyeing, C. G. Spenser, instructor in quantitative chemistry, R. H. Hook, assistant instructor in dyeing.